DOCUMENT RESUME

ED 262 237 CE 042 650

TITLE	Metals. Subject Matter Update 1986-87.
INSTITUTION	Oregon State Dept. of Education, Salem. Div. of Vocational Education.
PUB DATE	85
NOTE	20p.; For related documents, see CE 042 647-652.
PUB TYPE	Guides - Non-Classroom Use (055)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Basic Skills; Course Content; *Curriculum Development; Educational Objectives; *Education Work Relationship; Employment Opportunities; Employment Projections; Equipment; Job Skills; *Metal Industry; *Metal Working; Occupational Clusters; *Program Improvement; *Relevance (Education); Secondary Education; Skill Development; State Curriculum Guides; Statewide Planning; Trade and Industrial Education; Vocational Education
IDENTIFIERS	Oregon

ABSTRACT

This publication recognizes the constantly changing requirements of the metals industry and varying conditions for employment opportunities. It addresses the goal of relevance in education by enabling the educator to make timely adjustments in the subject matter of the metals curriculum. There are six sections in this publication, each of which can assist the vocational education teacher in evaluating and improving existing material and in developing new subject matter. The sections cover the following topics: (1) program goals in the metals cluster, (2) changing industry trends and trade practices, (3) employment trends in the metals cluster, (4) equipment needs, (5) subject matter changes, and (6) essential learning skills. By using this information, the teaching staff may achieve higher levels of classroom productivity--a productivity that not only recognizes future needs but also fosters strong linkages between educators, students, and the associated industries. (This update represents the opinions of industry people and is not the result of a detailed analysis of occupations.) (KC)

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Metals

Division of Vocational Education
Oregon Department of Education, Salem

Verne A. Duncan
State Superintendent
of Public Instruction

Subject Matter

Update

1986 - 87

Metals

1985

Oregon Department of Education
700 Pringle Parkway SE
Salem, OR 97310-0290

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Foreword

In keeping with the theme for excellence in education as established by the Oregon Action Plan, the Department of Education is enthusiastically committed to strengthening its ability to provide education that is relevant and applicable. An effective vocational education program will meet the needs of the students and, at the same time, meet the goals of the State's education system.

This publication, Subject Matter Update—1986-87, recognizes the constantly changing requirements of industry and varying conditions for employment opportunities. It speaks to the goal of relevance in education by enabling the educator to make timely subject matter adjustments.

There are six sections in this publication, each of which assists the vocational education teacher in evaluating and improving existing material and in developing new subject matter. By using this information, the teaching staff may achieve higher levels of classroom productivity—a productivity that not only recognizes future needs but also fosters strong linkages between educators, students, and the associated industries.

This update represents the opinions of industry people and is not the result of a detailed analysis of occupations. The educator should regard it as a tool for the review of program subject matter. For further information, contact the Division of Vocational Education, 378-2127.

Verne A. Duncan
State Superintendent
of Public Instruction

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INTRODUCTION

Vocational Education—Responding to the Future

Educators must deal with a great many issues during the remainder of this decade if vocational education is to respond to the needs of students as well as business, industry and labor. The Oregon Action Plan for Excellence in Education clearly calls for schools to provide a balanced and comprehensive curriculum for each student. Vocational education is an important part of that curriculum. As such, it is critical that programs in vocational education strive for excellence.

The most important component of excellence in vocational education is clearly the curriculum--what students are taught. Thus, it is essential that subject matter be kept as current as possible. As industries change directions, new job skills become necessary. Gradually, new occupations emerge as industry moves to incorporate new development technology.

There must be a system in place to capture this change and transform it into updated curriculum in vocational programs. It is not enough to say that five years from now there will be these new occupations requiring these kinds of skills and knowledge. Rather, curriculum should be evaluated frequently based on the best advice of people who work in those industries and occupational areas so that five years from now, students will be competitive in the labor market.

Meeting the Challenge

This is the concept that the Oregon Department of Education's Division of Vocational Education feels is essential to address. After all, subject matter really defines each occupational program, dictating facility and equipment needs, the skills of teachers and even the composition of program advisory committees. The first step then, is the formation of professional groups from industry and labor who have special knowledge about the needs and trends in their fields. Their task is to review program and course goals, and to give their views of industry changes and labor market needs. Through a grant from the Department of Education to Oregon State University, these technical committees will provide teachers with updated information every two years so that local programs can continually meet the challenge of excellence.

About the Technical Committee

The Oregon Department of Education and Oregon State University considered the staffing of the technical committee a critical factor for the success of this project. The individuals selected have outstanding records of achievement and significant prior working experience in the occupations covered in the Metals Cluster Program.

Members of the technical committee are

Tony Basting
Superintendent
Freightliner
West Linn

Bob Dixon
Instructor
Chemeketa Community College
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Metals Industry
Dependable Pattern
Portland

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Benson Polytechnic
Portland

This Subject Matter Update for Vocational Education Cluster programs is a joint project of Oregon State University and the Oregon Department of Education.

Program Goals in the Metals Cluster

Oregon has been using a goal-based planning system. This means that the State determines state goals; districts look to these state goals in working out their district goals; various programs consider the district goals as individual program goals are developed; and finally, course goals are formulated which support the program goals.

The technical committee members reviewed the State's Metals Vocational Cluster Program goals and unanimously determined that all of the goals continue to be important to the occupations within the field. The eleven established goals are given below in the order in which the committee ranked them—the most important listed first.

Students who complete the Metals Program

1. Will be able to perform mathematical calculations that are commonly used in the metal working industry.
2. Will be able to communicate through the written, spoken, and symbolic language of the metal working industry.
3. Will be able to select and use measuring tools common to the metal working occupations.
4. Will be able to work safely and apply proper first-aid procedures to metal working industry standards.
5. Will be able to select appropriate machines and methods for joining metal, and safely perform various joining operations.
6. Will be able to select appropriate machines and methods for cutting metal, and safely perform various cutting operations.
7. Will be able to select appropriate machines and methods for shaping metal, and safely perform various shaping operations.
8. Will be able to select appropriate equipment and methods for finishing metal, and safely perform various finishing operations.
9. Will be able to apply appropriate human relations skills in a work setting.
10. Will be able to utilize scientific data and principles common to the metal working industry.
11. Will be able to identify a variety of career options and career ladders including entrepreneurship available within the metal working industry.

The committee agreed unanimously to replace the term 'select' in the goal definitions with the term 'use'. They recommended that the student should not be held responsible for making 'select' decisions upon completion of secondary level vocational training. Instead, they commented that this form of decision-making should occur during advanced training, such as in the apprenticeship or community college programs.

Changing Industry Trends and Trade Practices

Industry Trends

The industries that employ graduates of the Metals Program are undergoing major changes, some of which may create new job opportunities in the future. Many will require a more sophisticated set of skills and knowledge.

The committee identified five trends and trade practices that will have the greatest impact on the Metals Program:

1. With the increasing use of automated equipment, there has been an increased need for workers who are more technically skilled. New processes are being continually developed which require that employees change their skills in order to match these new processes to product application and to customer needs.

2. Industry has emphasized that employees should have a broad range of job entry skills and know how to function or survive in smaller job shops.

3. Skill development is considered very important in various blueprint reading, precision sheet metal layout, computer numerical controlled tooling and punching machines, keyboarding, and display (CRT) readout.

4. Expertise is required in knowing how to properly apply sheet metal bend allowances, how to use automatic backing gauging on shears and press breaks, and how to deal with geometric dimensions and tolerances.

5. Students should have a basic working knowledge of the applications, operational functions, and maintenance requirements for computer-aided and robotic manufacturing.

The committee strongly recommended that all aspects of precision sheet metal operations be introduced at the high school level thus incorporating preparation for work in such industries as the electronics industry. Limiting vocational education to sheet metal instruction that is merely related to air-conditioning and heating systems does not adequately prepare students for meeting the needs of industries that demand high precision work. Along this line, the committee further noted that the electronics industry possesses great potential for improving the economic situation in Oregon. For this reason, the Metals Program should be prepared to meet the high standards set by the electronic industry, thus sharing in the effort to improve Oregon's economy.

The committee also noted that third-world nations are increasingly able to compete for less complex manufacturing operations, creating a trend that will cause an increasing shift of lower skilled manufacturing away from the United States. The outflow of work normally conducted in the United States has already had a devastating impact on both the nation's work force and economy. Until economic adjustments can be made to stabilize international trade, sheet metal personnel trained in this country must achieve higher skill levels in order to compete and maintain a job niche. Thus, the committee strongly endorses the inclusion of mathematics, communication skills, basic sciences, and continuing education in secondary level instruction.

Employment Trends in Metals

Today's graduates will enter a job market that already has a surplus of workers. Considering both future employment outlook and the number of existing oprograms, ideas for new program development and expansion of existing ones must be examined with care. More important, only those students who have been exposed to the appropriate programs, who have excelled in those programs, and who possess excellent skills in communication—reading comprehension, technical writing and oral expression—can expect to successfully compete for the limited job openings anticipated from 1986 to 1988.

The Oregon Employment Division forecasts metals employment in 1986 at 28,074 jobs, which includes 1,912 new openings in the state. The 1988 forecast is somewhat higher—30,453 employed, with 2,001 new openings anticipated. The unemployment rate among metals workers for 1983 was 24.2 percent, however 1984 reflected a lower unemployment rate of 19.5 percent.

Data from the 1984 State of Oregon Labor Market Information report is presented here to establish forecasts for employment conditions and job openings for 1986 and 1988 for each Classification of Instructional Program (CIP) within the Metals Cluster Program.

Automotive Body Repair. Reasonable employment opportunities exist due to above average demand including turnover. However, a surplus of workers is indicated for this CIP. The ratio of unemployed to openings is almost five to one. The unemployment rate for auto body repairers is above average at 20.6 percent. Additionally, on-the-job training plays an important role for this occupational group. Job openings are predicted to be 156 in 1986 and 164 during 1988.

Foundry. Reasonable employment opportunities do not exist due to a small demand in this CIP. Data indicate a balance between unemployment and openings, which is about one to one. The unemployment rate for furnace operators is below average at 6.1 percent whereas other subgroups have been as high as 38 percent. Job openings are expected to be 145 in 1986 and 149 during 1988.

Machine Shop/Tool Operation. Reasonable employment opportunities do not exist due to the large number of experienced, unemployed workers. Also, there is a surplus of workers for this CIP. The unemployment rate for machinists is above average at 37.3 percent. Machinists lost 30 percent of their employment between 1979 and 1982. Job openings are forecasted to be 736 in 1986 and 773 in 1988.

Sheet Metal. Reasonable employment opportunities do not exist due to the lack of construction activity and the oversupply of workers. The ratio of unemployed to openings is more than three to one. The unemployment rate for sheet metal workers is above average at 20.8 percent. The personnel supply primarily comes from on-the-job-training. Sheet metal workers lost 38 percent of their employment between 1979 and 1982. Job openings are anticipated to be 190 in 1986 and 200 during 1988.

Welding/Brazing/Soldering. Reasonable employment opportunities do not exist due to the large number of experienced, unemployed workers. The ratio of unemployed to openings is about eight to one. The unemployment rate for welders is considerably above average at 38.3 percent. Welders lost 33 percent of their employment between 1979 and 1982. Job openings are expected to be 408 in 1986 and 427 during 1988.

Precision Metal Work/Other. Reasonable employment opportunities exist; however a surplus of workers is indicated for this CIP. The ratio of unemployed to openings is greater than six to one. The unemployment rate for tool and die makers is 11.3 percent. However, several occupations in this CIP have over a 40 percent unemployment rate. Job openings are expected to be 169 in 1986 and 177 in 1988.

Plastics. Reasonable employment opportunities do not exist due to a small demand. The ratio of unemployed to openings is less than one to one. The unemployment rate for compression molding operators is below average at 7 percent. This occupation lost 33 percent of its employment between 1979 and 1982. Job openings are expected to be 50 for 1985 with a total employment of 807 by the end of the year.

In summary, a surplus of workers is indicated for this cluster. The ratio of unemployed to openings is greater than four to one. However, openings due to an industrial growth rate of 4.9 percent are considered to be above average. Even though the Oregon Employment Division indicates that there is a surplus of workers in this program now, industry maintains its concern about having an adequate supply of highly skilled workers for the future. Frequently, older workers who are reluctant to learn the new technologies that are changing their occupations will leave and thus create new openings which may be filled by younger, newly trained technicians. Therefore, it is imperative that competent replacement technicians be prepared to meet this need. It is more important than ever before to evaluate the training offered in the Metals Cluster. To prepare students for the future, all educators must understand where that future lies.

Equipment Needs

The members of the technical committee were requested to make recommendations regarding equipment needed in the Metals Program beyond the basic tools and shop equipment. They replied by stating that new equipment in use in today's modern foundry is far too expensive for a high school to procure. Instead, they recommended a basic knowledge of foundry practice along with exposure to new equipment and processes. This low-cost approach to instruction could be accomplished by industrial and school co-sponsored field trips and viewing of video tapes depicting current and future industrial trends. Essentially, the committee stated that strong attempts should be made to stimulate the student's interest in the various available job categories through the use of visual aids and field trips. Once the student developed interest in a specific vocational discipline, superior scholastic achievement and suitable individual behavior would be more likely to result.

The committee recommends exposure to

- Shear-decimal readout
- Press brake with automatic back gauging
- Computer numerical controlled punch press (also NC driven equipment)
- Digital readout measuring tools
- Computer-assisted design machines and robotic systems

The committee indicated that the State's high school shop equipment was not obsolete except for shaper tools. They stated that these should be replaced by CNC mills and lathes.

Subject Matter Changes

The technical committee was requested to evaluate current subject matter in the Metals Program. The following chart illustrates their judgment and indicates the relative importance they assigned to each subject matter item. A zero represents total obsolescence of the subject matter item and a five indicates maximum importance. The majority of the committee members indicated that all of the subject matter material is valid. The committee also listed its recommendations for future requirements, which are summarized at the end of the chart.

(1) SUBJECT MATTER ITEM		(2) RELATIVE IMPORTANCE RATE 0 - 5
1.0	SAFETY	
1.1	Attitudes-habits	5
1.2	Protective clothing/equipment	5
1.3	Lifting-carrying	5
1.4	Eye protection	5
1.5	Ear protection	5
1.6	Hand tools	5
1.7	Portable electric tools	5
1.8	Machines	5
1.9	Guarding	5
1.10	Dust, fumes, gases	5
1.11	Flammables	5
1.12	Fire prevention	5
1.13	Housekeeping	5
1.14	First aid, CPR	5
2.0	COMMUNICATIONS	
2.1	Read and interpret	
	a. Blueprints	3
	b. Symbols	2
	c. Terms-jargons	3
	d. Manuals, handbooks, catalogs, charts	2
2.2	Oral communications	
	a. Give directions	3
	b. Receive instructions	5
	c. Telephone	3
3.0	MATH	
3.1	Add, subtract, multiply, divide	5
3.2	Decimals	5
3.3	Fractions	5
3.4	Percent	5
3.5	Ratio and proportion	4
3.6	Algebra	5
3.7	Geometric principles	5
3.8	Areas, volume	5
4.0	SCIENTIFIC DATA/ PRINCIPLES	
4.1	Mechanical	
	a. Gears, belts, pulleys, levers	3
	b. Tensile strength	0
	c. Elasticity	0
	d. Machineability	3
4.2	Metallurgy	
	a. Properties of metal	0
	b. Heat treating	0
	c. Grain structure/changes	0
	d. Alloys	2
	e. Ferrous	0
	f. Nonferrous	0
	g. Testing	0
5.0	MEASUREMENT	
5.1	Metrication	0
5.2	Layout tools	5
5.3	Gauges	3
5.4	Micrometers	3
5.5	Verniers	3
5.6	Dial indicators	2
5.7	Height gauges	2
5.8	Gage blocks	2
6.0	CUTTING METAL	
6.1	Hand tools	
	a. Filing	2
	b. Drilling	3
	c. Taps/dies	3
	d. Shearing	5
	e. Sawing	4
6.2	Machines	
	a. Drill press	4
	b. Shears/punches	5
	c. Torches	5
	d. Bandsaws	4
6.3	Portable electric tools	5
7.0	SHAPING METAL	
7.1	Hand tools	5
7.2	Sheet metal machines	5
7.3	Lathes	4
7.4	Shaper	4
7.5	Vertical mill	3
7.6	Horizontal mill	3
7.7	Surface grinders	3
7.8	Pedestal grinders	5
8.0	JOINING METAL	
8.1	Hand tools	5
8.2	Fasteners	5
8.3	Sheet metal seams	5
8.4	Gas welding/brazing	5
8.5	Arc welding	5
8.6	MIG welding	5
8.7	TIG welding	5
8.8	Nonferrous	0
8.9	Soldering	5

	(1) SUBJECT MATTER ITEM	(2) RELATIVE IMPORTANCE RATE 0 - 5
9.0	FINISHING METAL	
9.1	Hand tools	5
9.2	Abrasives	4
9.3	Polishing	3
9.4	Spraying	3
9.5	Paints	3
9.6	Solvents	3
9.7	Thinners	3
9.8	Filing	0
9.9	Buffing	0
9.10	Sandblasting	0
9.11	Machine finishes	3
10.0	HUMAN RELATIONS	
10.1	Positive job attitude	
	a. Safe work attitude	5
	b. Responsible	5
	c. Punctual	5
	d. Honest	5
	e. Good health habits	5
10.2	Cooperative attitude	
	a. Follows instructions	5
	b. Works with others	5
10.3	Leadership	
	a. Craftsmanship	5
	b. Responsible for others	5
	c. Respect for others	5
	d. Accept help	5
	e. Gives help	5
	f. Self-direction	5
	g. Decision-making	5
11.0	CAREER OPTIONS ENTREPRENEURSHIP	
11.1	Working conditions	3
11.2	Job search	1
11.3	Routings for entry	1
11.4	Career ladders	1
11.5	Entrepreneurship	0

Recommendations for Subject Matter Evaluation

The committee offered these recommendations:

1. Teach science, mathematics, and communication skills with close application to the reality of precision metal work. Use practical and advanced problems in metals as the vehicle for teaching science and mathematics.

2. Provide more information through the use of industry media—trade journals and audio-visual aids—and well-planned field trips that will enable the student to better understand the importance of industry's demands, and, at the same time, actually visualize his or her position in a trade with a competitive edge.

3. Encourage the student to recognize his or her responsibilities in the organization—contributions, leadership roles, status congruence, and social influence.

4. Stress importance of customer relations.

5. Stress preventive industrial safety measures. Include this topic during field trips.

The technical committee also suggested future requirements for subject matter items to be taught during the next five years. They include when financially feasible

1. Computer numerical control—begin to plan for maximum instruction,

2. Computer-assisted design—provide a large amount of time to this topic, and

3. Robotic applications—maintain a low profile approach to this subject; however, be prepared to slowly escalate instruction in this area. Teach students about applications, operations, and maintenance.

Essential Learning Skills

Young people make the transition from school to work through a variety of means and circumstances. For some, the transition to a practicing career is done because of goal-oriented planning; for others, the transition may be by happenstance. Not too many years ago, the direction for a person's future work was determined principally by where he or she lived, the occupation of the father, and occupations of acquaintances and others. These provided sufficient exposure to jobs. Youth flowed fairly smoothly into the labor force.

Today, however, the transition for high school youth into the labor market is difficult. So is the transition for adults from obsolete occupations into different ones. In the years ahead, this transition promises to become more difficult because of major changes in the work force. These major changes will involve such factors as dual-career families, the impact of use of computers, the anticipated increase in white collar workers, a surplus of college graduates in relation to their job preparation areas, an increasing mismatch of skills and jobs, a growth in low-paying jobs, and an aging labor force.

A Lifetime of Learning

Thus, it becomes critical that students have the opportunity for further education and training so they can adapt to changes in society and their careers. Schools therefore must somehow prepare students to consider continuing education a viable and, in some cases, essential way to remain marketable in an increasingly competitive workforce.

Essential learning skills are those that individuals must master if they are to continue to grow, learn, and adapt to change. They are not unique to any one subject area; rather students must learn them in order to help them acquire any other knowledge and skills. They consist of reading, writing, mathematics, listening, speaking, study skills, and reasoning, including critical thinking and scientific method.

The Importance of Basic Skills

Employer studies, reports and articles all show that these skills are important. Writing and speaking skills are ranked first in employers' views of areas needing improvement. Acquisition of skills to read printed matter required for jobs ranked fifth. With 90 percent of the work force of 1990 already in the labor market and with an estimated 10 million workers identified as functionally illiterate, change seems to be the order of the day. Mastering basic, essential skills to equip future workers for change is an important outcome of modern vocational education.

Concerned Oregonians are evaluating the Essential Learning Skills publication. By reviewing a preliminary copy, action can be taken to produce an improved vocational cluster program. The Department's Curriculum Director is prepared to furnish information and progress reports upon request for this important phase of the Action Plan for Excellence.

The following outline of performance standards for essential learning skills represents the range of skills that vocational teachers can teach and reinforce as they perform subject matter updating.

Students will be able to

1. **Demonstrate use of vocabulary, speech, numerals (figures, letters, words) and other appropriate symbol systems essential for effective communication, computation and problem solving**

   1.1 Recognize words commonly used in grade-level materials

   1.2 Determine meaning of unknown words commonly used in grade-level materials

   1.3 Speak with standard pronunciation, appropriate volume, rate, gestures and inflections

   1.4 Use number/numeric figures, letters, words, symbols, concepts to count, compute and communicate quantitative data

   1.5 Recognize and use geometric patterns, relationships and principles to describe and classify

   1.6 Recognize and use mathematical patterns, relationships and principles to quantify problems or make predictions

   1.7 Estimate and measure quantities, areas and objects, define problems, develop hypotheses, select appropriate methods of computation, solve problems

2. **Interpret the literal meanings of information in written, visual and/or oral communication**

   2.1 Identify main ideas, supporting details, facts, and opinions presented in written, oral and/or visual formats

   2.2 Use instructional materials as basis for gaining knowledge and/or improving comprehension

   2.3 Use oral communication to give/receive information and/or directions

3. **Interpret the implied meanings of information presented in written, oral and/or visual communications**

   3.1 Comprehend implied meanings of written and oral communication

   3.2 Use oral communication to imply meanings and convey ideas, feelings, attitudes

4. **Evaluate content and use of oral, audio and visual communications**

   4.1 Make judgments about the significance and accuracy of information and ideas presented in written materials

   4.2 Use oral communication to respond to others' efforts to persuade and/or to influence others' beliefs and actions

   4.3 Listen with discrimination to the sounds of nature, language, music, and environment

   4.4 Listen, read, view presentations of mass media with discrimination

5. **Generate, organize, express, and evaluate ideas in oral, written, or visual forms**

   5.1 Use a variety of techniques to generate writing and speaking topics (prewriting)

   5.2 Organize ideas in understandable sequence: introduction, body, conclusion; problem solving; spatial, chronological or topical (prewriting/planning)

5.3 Select appropriate form of writing based on audience and purpose

5.4 Present ideas in understandable sequence on the topic selected (drafting)

5.5 Use language, gestures, symbols appropriate to audience, purpose, topic and setting to convey oral information (making oral presentations)

5.6 Evaluate and revise own writing for meaning, clarity, and comprehensiveness (revision)

5.7 Apply the conventions of writing to produce effective communication (editing and proofreading)

6. Plan and carry out problem-solving strategies related to varied assignments in an organized and systematic manner

6.1 Use problem-solving strategies to address varied assignments

6.2 Select most appropriate tools, methodologies, processes, operations in solving problems related to varied assignments

7. Manage time, instructional resources, and personal habits and attitudes constructively in order to accomplish learning tasks

7.1 Clarify purposes of assignment

7.2 Use resources beyond the classroom

7.3 Use study techniques

7.4 Use reading rate appropriate for assignment

7.5 Follow a study plan

7.6 Keep study materials organized and accessible

7.7 Maintain appropriate physical and emotional practices

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